

Abstract

A natural gas reformer comprising a stack of thermally conducting plates interspersed with catalyst plates and provided with internal or external manifolds for reactants. The catalyst plate is in intimate thermal contact with the conducting plates so that its temperature closely tracks the temperature of the thermally conducting plate, which can be designed to attain a near isothermal state in-plane to the plate. One or more catalysts may be used, distributed along the flow direction, in-plane to the thermally conducting plate, in a variety of optional embodiments. The reformer may be operated as a steam reformer or as a partial oxidation reformer. When operated as a steam reformer, thermal energy for the (endothermic) steam reforming reaction is provided externally by radiation and/or conduction to the thermally conducting plates. This produces carbon monoxide, hydrogen, steam and carbon dioxide. When operated as a partial oxidation reformer, a fraction of the natural gas is oxidized assisted by the presence of a combustion catalyst and reforming catalyst. This produces carbon monoxide, hydrogen, steam and carbon dioxide. Because of the intimate thermal contact between the catalyst plate and the conducting plates, no excessive temperature can develop within the stack assembly. Details of the plate design may be varied to accommodate a variety of manifold embodiments providing one or more inlets and exit ports for introducing, pre-heating and exhaust the reactants.